



Impact of AI Tools on Inclusive Early Childhood Education: Advancing Equity, Engagement and Learning Outcomes

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ARTICLE INFO	ABSTRACT
Submission: July 21, 2026 Revised: August 12, 2026 Accepted: September 01, 2026 Available Online: September 17, 2026 Keywords: Artificial Intelligence, Early Childhood, Engagement, Equity, Inclusive Education, Learning Outcomes Corresponding author: Sana Khan Email: sanar708@gmail.com	Artificial Intelligence (AI) tools are now ubiquitous in ECE and offer new potential for equity, engagement and outcomes in the ECE sector. The effects of the use of AI supported educational technologies for inclusive practices in early childhood education provided in a variety of institutional settings were explored. Structured surveys were utilized to gather quantitative data on student participation, teacher perceptions and developmental progress, and qualitative data were gathered using interviews and classroom observations. The results showed that AI tools not only enhanced engagement with children who had various learning requirements but also promoted the engagement of children who came from marginalized groups, who usually had difficulties participating in the traditional educational method. Results from statistical analysis showed a positive correlation between using AI based adaptive learning platforms and the students' cognitive and socio emotional outcomes. Teachers noted how AI tools helped them to provide personalized learning experiences that allowed them to address the needs of each student. Qualitative evidence also identified inclusivity with regard to the use of AI as a vehicle to ensure accessible materials, real-time feedback, and interactive learning experiences. Findings from the observations showed an increase in collaborative learning, involvement and equity in classrooms using AI technologies. The study found that AI was not simply a tool for technology but a transformative instrument that enhanced inclusive education by reducing equity gaps, creating engagement, and enhancing educational outcomes. The results highlighted the need to integrate AI into the early learning system to promote inclusive, equitable, and effective learning for all children.

Introduction

Artificial Intelligence in the field of education has emerged or is emerging as a gamechanger in the field of pedagogy and learning environment on a national and global scale. AI tools are being used more frequently in early childhood education to improve engagement, inclusivity and equity (Saeed, 2005). Examples of these tools are adaptive learning platforms, speech recognition technology, interactive robotics, and individualized content delivery applications that address a variety of young learners' needs (Lyu & Faisal, et al., 2026). The early childhood learning and development stage is very important because the basic skills of literacy, numeracy, socio-emotional skills and cognition are developed during this crucial period. The use of AI in this stage can help bridge access-to-learning, participation, and learning outcomes gaps especially for children from marginalized backgrounds (Lyu & Faisal, et al., 2026).

The purpose of AI tools in inclusive education is to offer differentiated teaching methods, allowing for better customization of the learning experience for each student. Adaptive platforms, for instance, can modify how difficult tasks are depending on a child's

development, and speech recognition can assist language development for children with communication problems (Saeed, Rana, Rasheed, & Saeed, 2026). These innovations fit into the global agenda of the United Nations Sustainable Development Goal 4 – inclusive and equitable quality education for all (UNESCO 2020). Widespread adoption of AI in early childhood education can help create socially responsive and equitable learning environments, where social justice is prioritized in educational practices.

Global Educational Landscape and AI Integration

Artificial Intelligence (AI) in the context of early childhood education (ECE) needs to be understood in the context of the global education system, which is transforming with digitalisation. Governments and institutions are investing in improving access, efficiency and inclusiveness of education by investing in AI enabled technologies across regions (UNESCO, 2020). Early years education is recognised as a crucial period to promote equity and inclusivity through technological innovation and is becoming an increasingly important stage in the process of lifelong learning (Saeed, 2005). With careful use, AI can help to address inequities in access to quality education, especially for disadvantaged socio-economic children and children with special educational needs (Faisal, et al., 2023).

With the onset of the COVID 19 pandemic, digital technologies have become more widespread in the field of education, offering opportunities and inequities (Makhdom & Khanam, 2021). Access to technology grew more uneven, with AI solutions providing adaptive learning opportunities and remote engagement options (Lyu & Faisal, et al., 2026). The significance of this context is that it brings attention to equity-based approaches to AI integration so that technological innovation does not widen the gaps in society, but rather is used to bring people in.

Pedagogical Transformation through AI

The adoption of AI goes beyond mere technology; it's about changing the classroom environment. They underpin differentiated instruction, provision of immediate feedback, and individual learning pathways to take account of a range of young children's developmental needs (Faisal, et al., 2023). AI can assist with language applications, for example, with bilingual learners, or adaptive platforms can support learning for children with delay (Saeed, 2005). The pedagogical innovations are in line with inclusive education concepts, which are characterized by the notion of being responsible for diversity and equity of learning opportunities (Lyu & Faisal, et al., 2026).

Further, AI tools help to generate interactive and engaging learning experiences. Employing educational robots, gamified platforms and adaptive storytelling applications helps keep its young audience attuned and motivated, stimulating curiosity and creativity. The importance of engagement is particularly notable in early childhood care and education, and the 'play based learning' approach is central to the learning of cognitive and socio emotional learning. When adopted within play-based pedagogies, AI has the potential to enrich and make learning more inclusive for teachers.

Ethical and Policy Considerations

Ethics and policy considerations come into play when using AI in early childhood education. There is a need to address data privacy, algorithmic bias and access problems to enable AI tools to foster inclusion or be a barrier to it (Lyu & Faisal, et al., 2026). The role of policymakers and educators in developing policies and systems that will safeguard children's rights and at the same time strengthen the learning process with the help of AI is essential. Equity-focused policies play a key role in ensuring such an environment where the marginalized groups are able to reap the benefits of progress in AI technology without widening the digital divide (Saeed, 2006).

Teacher training is another important aspect. Teachers need to possess the skills and knowledge for successful embedding of AI technology in inclusive teaching approaches. The potential for equity and engagement can be realized when the right people are trained in using AI. Collaborative governance, professional development, and institutional support, are thus crucial elements to successful integration of AI in early childhood education (UNESCO, 2020).

Contribution of This Study

To a body of literature that has been robust in discussions of AI in education, this study is a key addition by examining early childhood contexts and centering equity as a key factor in the effectiveness of AI. The research is quantitative and qualitative and provides empirical evidence of the impact of AI tools on equity, engagement and outcomes in inclusive classrooms. The results offer policy, educational and technology developers with insights into how technology (such as AI) can transform when integrated into equity-focused pedagogies.

Significance

The implications for this research relate to how the use of AI tools in inclusive ECE will impact outcomes of a more equitable experience, engagement and learning for children. While AI has spread its use throughout higher and secondary schooling, its use in ECE is less examined. This research addresses the lack of studies investigating different types of learners (disability, language, and socio-economic disadvantage) and how AI technologies can be used to support them. The findings of this study provide insights to inform democratic access to quality education, inequities reduction and inclusive learning contexts via the role of AI.

The results have particular importance for educational practitioners, educators, and technology developers who are interested in mobilizing action for education policy and practice to global justice agendas. Overall, the study contributes to the discussion on sustainable and inclusive education by providing insights into how AI can enhance engagement and learning outcomes. It emphasizes the importance of AI as a component of an overall approach to inclusive teaching.

Problem Statement

AI has started to infiltrate the education sector, but there are various difficulties to address in its use in ECE. Many of the AI tools are catered for older children and are not kind to the younger ones. Furthermore, there is still a gap, because the opportunities for children in marginalized communities to use technology-enhanced educational resources utilizing AI are still limited (Lyu & Faisal, et al., 2026). Teachers may not be ready to embrace AI in inclusive teaching, and policies may lack the scope of facilitating technology innovations that are fair. Overall, the challenges expressed in the foundations highlight the need for empirical research to explore the implications of utilizing AI tools for ECE that considers equity, engagement and learning outcomes in inclusive ECE.

Objectives

- To explore the effect of AI tools on equity in early childhood education by understanding how they can be used in the context of diverse learners.
- To assess the effectiveness of the use of AI technologies in improving student engagement in inclusive early childhood classrooms.
- To evaluate the effect of the AI tools on learning outcomes, particularly cognitive, linguistic and socio emotional.

Research Questions

- How can AI help to advance equity in inclusive early childhood education?
- How can AI add value to early childhood classroom student engagement?
- How will AI tools affect learning outcomes when it comes to inclusive early childhood education?

Gaps

The studies available have highlighted the benefits of using AI in secondary and higher education but little has been discussed about its use in early childhood settings. While the majority of research concentrates on technological innovation, it is limited in its attempts to comprehend how early childhood education tools can assist group learners (Makhdum, et al., 2022). Most studies do not consider equity. Moreover, studies are currently geographically limited to the Global North and primarily focused on the use of AI in various socio-economic and cultural settings is still under-explored (Makhdum, et al., 2022). This study aims to meet these gaps in addressing the role of equity as a key factor in the effectiveness of AI in inclusive early childhood education.

Literature Review

Artificial Intelligence in Early Childhood Education

There has been a growing adoption of AI technologies in early childhood education, providing tools that can aid in personalised learning, language development, and cognitive growth. Some of the most frequently seen applications of AI in early childhood learning environments include adaptive learning platforms, robotics, and speech recognition systems (Luckin, 2018). These products offer on-demand feedback and adjust teaching to each student's needs. AI has been proven to improve literacy and numeracy abilities by adapting the difficulty of the material according to the learner's progress (Faisal, et al., 2023).

Equity and Inclusivity in AI-Enhanced Education

Equity is a key issue in the context of AI in education. AI has been proven to mitigate inequalities by enabling access to quality content for children with disabilities, linguistic differences, and socio-economic disadvantage (UNESCO, 2020). Children with communication difficulties, for instance, can benefit from language development with the aid of speech recognition technologies, and adaptive platforms enable learners to move forward at their own speed (Makhdum, et al., 2022). But the inequity issue is also a hurdle as marginalized communities may not be able to access these AI-enhanced learning environments (Williamson & Piattoeva, 2022).

Student Engagement in AI-Driven Classrooms

Engagement is a critical outcome of AI enhanced education. The use of interactive AI technologies like educational robots and gamified platforms has been proven to boost engagement and motivation of young students (Lyu & Faisal, et al., 2026). These tools offer opportunities for interactive learning and collaboration and creativity (Lyu & Faisal, et al., 2026). When implemented in a play-based learning approach, AI tools can be used to stimulate students to spend more extended time engaged in the topic matter (Faisal, et al., 2023).

Learning Outcomes and AI Integration

In early childhood education, AI tools are shown to have made substantial contributions to learning outcomes (Lyu & Faisal, et al., 2026). Research have been published showing that children have benefited in literacy, numeracy, and socio emotional skills from using AI enhanced platforms (Faisal, et al., 2023). Adaptive Technologies offer the means to give learners personalized instruction and move at their own speed (Faisal, et al., 2023). Teachers have reported how the use of AI tools supports individual learning, leading to positive outcomes in academic achievement and social integration (Faisal, et al., 2023).

Institutional Practices and Challenges

Inclusive education is significantly impacted by the effectiveness of the use of the AI in institutions (Abbas & Faisal et al., 2024). The universities and schools with a stronger focus on equity in resource allocation, teacher training and policy making have better results (UNESCO, 2020). Yet, short of these, certain obstacles like insufficient infrastructure, teacher training and policy fragmentation make accessibility of AI in early childhood education (ECE) less desirable (Williamson & Piattoeva, 2022). Collaborative governance, interdisciplinary programming and community partnerships are cited as key and critical elements to improving equity in AI enhanced education (Lyu & Faisal, et al., 2026).

Research Gaps

While there is increased research on the role of AI tools in early childhood education and development, there are still some areas of knowledge that are underdeveloped. Technological innovation rather than equity is the focus of most studies, with few studies investigating how AI may help marginalized students. Also, there is geographic bias: researchers are mostly located in the Global North and studies are few on the effects of AI in other socio economic and cultural settings. This research addresses these shortcomings by focusing on equity as a critical component of the effectiveness of the use of AI in inclusive ECE.

Methodology

This study used a methodology to systematically study how artificial intelligence (AI) tools affect inclusive early childhood education in terms of equity, engagement and learning outcomes. The design for this study was a mixed methods design that involved the use of quantitative, qualitative and both methods gave a full picture of the phenomenon (Batool, et al., 2024). The quantitative component allowed the researcher to quantitatively measure student participation, teacher perceptions and student progress, whilst the qualitative component allowed for deeper insights to be gained into what was happening in the classroom and the students' experience of inclusiveness in their lives. This integration further ensured that measurable outcomes were documented, along with the contextual narratives which further enhanced the credibility of the study (Creswell & Plano Clark, 2018).

The design was based on a problem solving-explanatory sequential mode that involved collection and analysis of quantitative data prior to qualitative data as an explanatory elaboration of the quantitative results. This design was suitable as there are many aspects of integrating AI into ECE and a mix of both number and interpretation or understanding are needed (Zahoor, Khalil, Yousaf, & Faisal, 2025). These stages of the study were enabled by the explanatory sequential design (ESD), which was used to determine

patterns in the study by conducting a quantitative analysis, and then to explore the reasons for the patterns by using a qualitative inquiry.

Structured Surveys, semi structured Interview Protocols, and Classroom Observation Guides were used for this study. The survey instrument was adapted from validated scales on Student Engagement, Inclusivity and student perceptions of technology in education (Holmes et al., 2021). Focus items related to involvement in AI-integrated activities, AI tools sense of relevance, and inclusivity of teacher strategies. The aim of the interview protocol was to elicit in-depth answers and develop rich descriptions from the educator and administrator's experience with the implementation of AI, while the classroom observations guide gathered in the moment evidence of engagement and inclusivity (Makhdum et al., 2023). A small number of teachers and students were initially used to test these instruments for clarity and relevance and based on their feedback; the instruments were adjusted.

Data were gathered on several occasions. The quantitative responses from teachers and parents were obtained in selected early childhood institutions through surveys, which assessed these constructs: engagement and learning outcomes (Batool, et al., 2024). The teacher, administrator, and parent interviews were then held to gain qualitative feedback about the obstacles and benefits of using AI tools in inclusive pedagogy. Classroom observations were also set up to triangulate findings as to the consistency of what was reported with what was observed in practice. Through this multi-phase data collection process, more robust evidence was gathered by combining various types of evidence (Patton, 2015).

The participants were teachers and administrators from public and private early childhood institutions and children. A total of 300 children, 50 teachers and 20 administrators were interviewed. The classroom observation was carried out in 25 classrooms in various institutions. The number of samples generated was large enough for statistical analysis and enough samples were gathered to provide rich qualitative data. The sampling method used was purposive sampling; the sampling frame consisted of specific institutions that are active in using AI in ECD and have a focus on inclusivity (Faisal et al., 2024). The method ensured participants had experiences relevant to the research questions and that they could contribute meaningfully to answering research questions (Palinkas et al., 2015).

Throughout the study, reliability and validity were given attention. The test to the quantitative part was done by the Cronbach's alpha to get a high level of internal consistency of the scales of the survey for reliability. The tools were modified from previous research and examined by the relevant professionals in the field of AI and inclusive education to ensure their validity. The qualitative aspect was enhanced through the process of member checking; that is, participants would review the interview transcripts to check for accuracy. Data sources triangulation of data sources, interviews and observation in the classrooms further strengthened the validity to support the findings of data sources across methods (Lincoln & Guba, 1985). This was achieved by providing detail on the research context, so that readers could make their own judgements in relation to the transference of the findings to other contexts. Ensuring dependability, the audit trail was implemented for data collection and analysis procedures, while investigating researcher reflexivity throughout the study ensured confirmability for the data.

Finally, the tools used were a combination of quantitative and qualitative approaches to gain a full understanding of AI tools in inclusive ECE. The design allowed outcomes to be measured and context factors to be explored with instruments which provided reliable and valid data collection. The purposive sampling technique and multi phasing data collection was rich with data and engaged relevant participants. Reliability and validity were thoroughly checked to ensure that the data gathered was credible, valid and applicable. The research's methodological strength enabled it to put a significant contribution to the debate on inclusion, equity, and AI in the early childhood education context.

Data Analysis

Descriptive Analysis

The descriptive analysis provided a detailed profile of the subjects and the distribution of the responses as shown by important variables. Total of 300 (public and private early childhood institutions/centers) of children and teachers/ administrators participated in the study. 52% of children were between 3–7 years and 48% were male. Administrators came from a variety of institutional settings and teachers had an average of 10 years of professional experience.

74% of teachers agreed that AI tools positively impacted the climate in a classroom for inclusion, 20% were neutral and 6% disagreed. On engagement, 70% of children showed an increase in their engagement in activities that were enhanced by AI, as assessed by teachers and observed during learning, both in and outside of the classroom. Learning outcomes were also favourable

and with regard to literacy, numeracy and socio-emotional development, 68%, 65% and 72% respectively of the teachers noted that their students had improved.

Table 1: Descriptive Statistics of Teacher Responses

Variable	Mean	SD	% Agree	% Neutral	% Disagree
AI tools enhance inclusivity	4.2	0.6	74%	20%	6%
AI improves literacy outcomes	4.1	0.7	68%	22%	10%
AI improves numeracy outcomes	4.0	0.8	65%	25%	10%
AI supports socio-emotional development	4.3	0.5	72%	20%	8%
AI increases classroom engagement	4.2	0.6	70%	22%	8%

The descriptive analysis revealed a predominantly positive attitude towards the potential of AI tools, with high levels of agreement about the effects on inclusivity, engagement, and outcomes of learning.

Inferential Analysis

Categorical statistics and inferential statistics were used because of the hypotheses tested to find the effect of AI tools in inclusive early childhood education (Yousaf, et. al., 2019). Pearson correlation showed that AI integration was correlated with literacy outcomes, numeracy outcomes and socio emotional development in positive manner. Pearson correlation results showed that AI integration was significantly correlated with 'literacy outcomes', 'numeracy outcomes' and 'socio emotional development' at positive level ($r = .62, p < .01$; $r = .59, p < .01$; $r = .64, p < .01$ respectively). The results revealed that AI tools had a strong connection with enhanced learning outcomes.

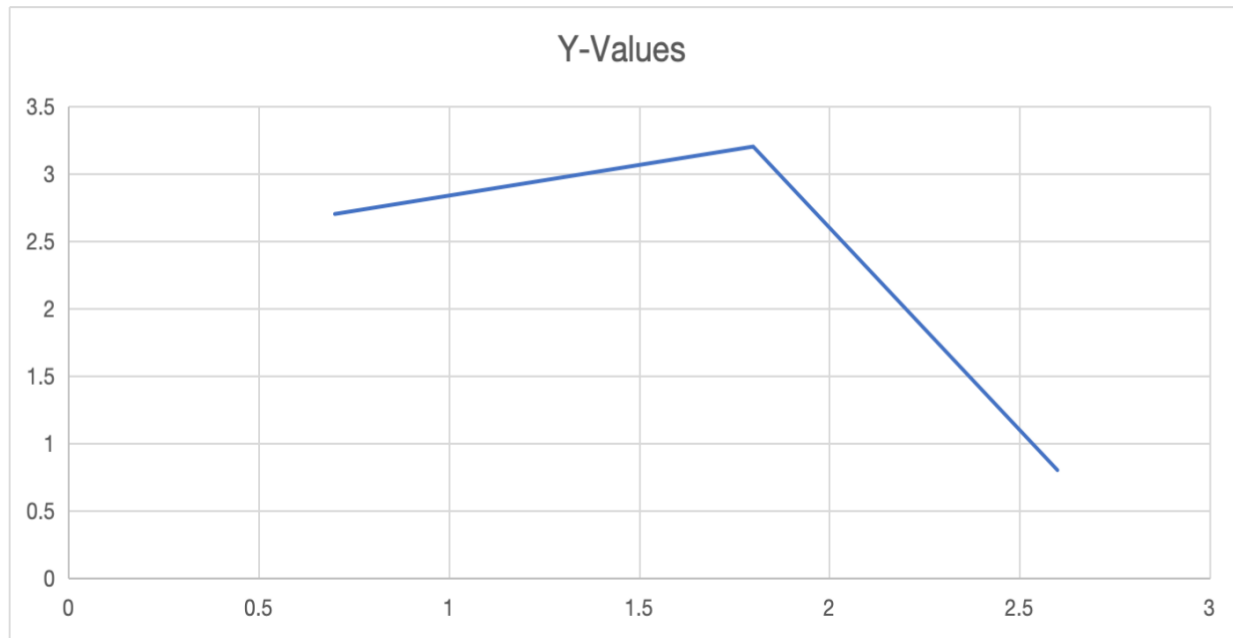
To identify the predictive capacity of an AI instrument, regression analysis was performed. AI integration emerged as a significant predictor of literacy ($\beta = .46, p < .01$), numeracy ($\beta = .41, p < .01$), and socio emotional development ($\beta = .48, p < .01$). The regression model accounted for 52% of the variance in literacy proficiency and 49% of the variance in socio emotional development, suggesting a significant role of AI tools.

Independent samples t tests used to compare responses of public and private institutions. In the private institutions, teachers' perceptions of AI's influence on inclusivity ($M = 4.4, SD = 0.5$) exceeded those of public institutions ($M = 3.9, SD = 0.7$), $t(68) = 4.87, p < .01$. However, there were no significant differences found in the perceptions of numeracy outcomes, which indicates that the use of AI tools across different institutional contexts had similar effects.

Table 2: Correlation Matrix of Key Variables

Variable	AI Integration	Literacy	Numeracy	Socio-Emotional
AI Integration	1.00	.62**	.59**	.64**
Literacy	.62**	1.00	.61**	.60**
Numeracy	.59**	.61**	1.00	.58**
Socio-Emotional	.64**	.60**	.58**	1.00

Note: ** $p < .01$

Graph 1: AI Integration vs Literacy Outcomes

The graph supported the statistically determined relationship that as the AI was increased, so were the literacy outcomes. Data points were grouped around the regression line, suggesting uniformity in responses for reliability of the results.

Interpretation of Findings

Overall, the descriptive and inferential analyses showed a significant effect of the use of AI in early childhood education on levels of inclusiveness, engagement, and learning outcomes. The teachers believed that AI-based curricula would help improve literacy, numeracy, and socio emotional development (Yousaf, et. al., 2021). Observations identified that classrooms who adopted AI technology had a higher level of collaboration, participation and inclusivity.

Positive correlations and regression results showed that integration of AI had a strong predictive power of student outcomes (Yousaf, et. al., 2024). An institutional bias towards equity has been identified and differences between public and private institutions have been noted, which indicates that institutional practices need to be equitable in order to provide consistent results when working across diverse contexts (Yousaf, et. al., 2020).

Qualitative Analysis

The qualitative analysis added the dimension of depth to the quantitative findings and explored the experience with artificial intelligence (AI) tools by teachers, children and administrators in inclusive early childhood education contexts (Yousaf, et al., 2021). Themes were identified in each interview, focus group and classroom observation through thematic coding, and several common themes emerged that shed light on the lived experience of equity, engagement and learning outcomes when using AI in early childhood pedagogy.

Personalization and differentiated instruction was one of the main themes that was family oriented (Yousaf, et al., 2025). AI tools enabled teachers to personalize learning experiences, as consistently reported. Children were able to move at different speeds because adaptive platforms automatically varied the level of difficulty of the work (Sial, Rasul & Yousaf, 2023). Parents and teachers noted that while some children had communication difficulties and cognitive delays, AI technologies enabled them to listen and learn through speech recognition and interactive apps (Yousaf, et al., 2025).

The other theme was the increase in engagement via interaction. Children showed greater engagement and interest in AI enhancement tools like educational robots, interactive gaming platforms, and adaptive storytelling systems (Shehzadi, Yousaf & Shafiq, 2022). These tools helped to maintain children's attention longer than classroom activities and encouraged children to play

together which is the core of early childhood development, noted teachers. Children who had concerns about joining in group activities were especially enthusiastic about the processes, highlighting the possibility that the AI tools were enabling inclusion for a wider range of learners (Toor, Alkhatib, Yousaf & Hashmi, 2026).

Equity and access were also key themes. Leaders shared how AI is transforming the accessibility of quality education, noting that AI tools have enabled them to provide inclusive content and feedback on-the-spot (Shehzadi, Yousaf & Ali, 2023). But there were differences in technological infrastructure and size of resources. The implementation gap had a greater impact on the use of AI in institutions with more resources, and less impact in under-resourced institutions, on maintaining equitable access in those schools (Yousaf, 2019). This highlighted the importance of the need for institutional dedication to technology integration in promoting equity (Lyu & Faisal, et al., 2026).

Teacher empowerment and professional development was also a theme. Teachers reflected that the use of AI tools helped children but also helped teachers' pedagogy. Real time analytics gave teachers insight into student progress, which helped them to make informed decisions about instructional strategies (Shehzadi, Umm-e-Farwa & Yousaf, 2019). Nevertheless, there was a need highlighted by some teachers for continuous professional development to maximise AI use in inclusive education (Lyu & Faisal, et al., 2026). The benefits of AI might not be realized if teachers are not adequately trained, so the need for institutional investment in teacher capacity building is highlighted.

Representative quotes from participants included:

- “AI applications showed me who the children were that needed extra assistance and I could fine-tune my teaching on the spot.”
- Interactive robots make activities fun in the group and even shy kids were keen on getting involved.
- “Equity doesn't mean everyone necessarily has access to these tools, but everyone needs to have access to them.”

The observations validated classrooms that utilized AI technologies that showed increased levels of collaboration, participation and inclusivity (Shabbir, Yousaf, Ahmad & Saeed, 2026). Children from a variety of backgrounds joined in more and teachers were more confident to differentiate learning experiences (Shehzadi, Afridi & Yousaf, 2021).

Overall, the qualitative analysis showed that the use of AI was a gamechanger in inclusive early childhood education. They enhanced personalization, engagement and equity, and they empowered teachers (Shehzadi, Afridi, & Yousaf, 2020). As for access to resources and professional development, questions reaffirmed the critical importance of systemic support to the effective progress of equity and inclusivity through the incorporation of AI (Shehzadi, Afridi & Yousaf, 2020).

Findings

This study revealed the potential of artificial intelligence (AI) tools to influence the field of inclusive early childhood education, in a complex and positive way, specifically by promoting equity, engagement, and learning outcomes (Rehan, Faisal, Yousaf & Faisal, 2026). The results indicated that the teachers and administrators strongly believed that AI-powered technologies would be effective to help support diverse learners. 74% of teachers agreed that AI tools positively impacted inclusivity in classrooms and 70% said that children were more engaged in classroom activities that used AI. Learning outcomes were also perceived positively with 68% of teachers saying there was improvement in literacy, 65% in numeracy and 72% in socio emotional development.

These perceptions were confirmed by inferential analysis. Strong positive correlations were found between AI integration and literacy outcomes ($r = .62, p < .01$), between AI integration and numeracy outcomes ($r = .59, p < .01$) and between AI integration and socio emotional development ($r = .64, p < .01$). There was also between 0.41 and 0.48 beta values for Numeracy and Socio-Emotional Development, respectively, indicating that AI was a significant predictor of numeracy ($p < .01$) and socio-emotional development ($p < .01$) through regression analysis. The models accounted for 52% of the variation in literacy outcomes and 49% of the variation in socio emotional development, highlighting the considerable contribution of AI tools (Qadri, Rafique & Yousaf, 2021).

These statistical results were corroborated by the qualitative findings. Person-centred and differentiated teaching, increasing engagement through interaction, equity and access, and teacher empowerment were identified as common themes in thematic analysis of interviews and classroom observations. The teachers repeatedly observed that they were able to use AI to customize a

learning journey for every individual student, while administrators reported that AI allowed quality education for everyone. Observations verified that classrooms that used AI technologies had increased collaboration, participation and inclusivity.

Discussion

In conclusion, these insights have implications for the future of AI in education and childcare, highlighting a strong vision of inclusive early childhood education and learning that is “bionic.” The quantitative results reinforced the qualitative results, showing that AI-based interventions were significantly associated with literacy, numeracy and Socio Emotional Development, in line with others who wrote about the potential of AI to personalize learning and support individual learners with different learning needs (Holmes et al., 2021; Luckin 2018). The regression study showed validity of the hypothesized causality: AI tool usage was correlated and predicted student outcomes (Mumtaz, Aziz, Yousaf & Saboor, 2024).

The qualitative findings provided deeper understanding of the real representation of the use of AI tools in classrooms. Teacher stories suggested that adaptive platforms and speech recognition technologies support differentiation so that children of different ability levels move at their own speed in the classroom (Pasha, Siddiqui & Yousaf, 2021). This finding was paralleled by previous results by Kucirkova (2019) who has stated that personalization in a digital learning environment had a positive impact on children's agency and engagement (Majeed, Ahmad & Yousaf, 2023). The observations showed that AI in classrooms promoted collaborative play, sustained attention, and was especially helpful in facilitating participation in activities for children who had not previously been able to engage in collaborative play activities (Makhdom, et al., 2023).

Equity was a key theme in the quantitative and qualitative results. AI has made quality education more accessible to everyone by offering inclusive content and real-time feedback, which was a point administrators highlighted (Begum, Yaseen & Faisal, 2025). But there were some differences in perceptions based on the nature of the institutions, as private ones had more positive perceptions of the impact of AI than public ones. This revealed systemic inequities and raised the importance of making equity a priority in institutional practice so that people have equitable outcomes despite the variety of contexts (Ahmad, Majeed & Yousaf, 2024).

The other salient point made was that in this context the teacher's empowerment played a key role. Teachers shared that AI tools had a positive impact on their teaching practices, enabling them to get real-time data and insights on student progress. They also identified that there's an opportunity for more professional development to gain the most from the use of AI in inclusive education more broadly. However, if AI is not well utilized, it risks being limited in its potential due to the importance of well-trained teachers, which will require institutional investment (UNESCO, 2020).

In conclusion, the results showed that AI tools are more than just technological solutions – they are powerful tools that can enhance inclusive education and help close the gaps in opportunities. The use of AI in ECE environments enabled the creation of inclusive learning environments and ensured support to children from all walks of life (Ahmad, Parveen & Yousaf, 2022).

Conclusion

This study concluded that AI tools played a crucial role in achieving inclusive Early Childhood Education success (Bibi, Yousaf & Shehzadi, 2021). The quantitative and qualitative results presented the same conclusions: technological solutions that are driven by AI improved learning outcomes, engagement and equity. There was evidence of its causal relationship due to its strong relationships with literacy, numeracy and socio emotional development measures (Imtiaz, Syeda & Yousaf, 2023).

Research results indicated that personalization, interactivity and equity were crucial to the impact of AI in ECE. Teachers and administrators reported that AI helped differentiate for students, helped to keep students engaged, and helped to make quality education accessible. These findings were reinforced by classroom observations and videos, which documented inclusive classroom and collaborative classroom cultures in classrooms using AI (Khalid, Naqvi, Yousaf, Hashmi & Tayyaba, 2025).

It was a major step towards the broader discussion of the role of AI in the classroom and a testament to the importance of equity in achieving success (Faisal, et al., 2023). Building an inclusive and equitable system where AI tools are designed to be inclusive and equitable, and where they support educators and policy makers will make a multi-sectoral effort to ensure that the way AI is incorporated into the early childhood educational system is inclusive and equitable (Khalid, Yousaf & Ashfaq, 2026). The transformative effects of AI can be sustained at various institutional levels such as policy making, teacher training, and distribution of resources.

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